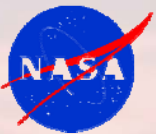


CO₂ Capacity Sorbent Analysis Using Volumetric Measurement Approach

Roger Huang, KBR Wyle, NASA ARC
Tra-My Justine Richardson Logyx LLC, NASA ARC
Grace Belancik NASA ARC
Darrell Jan NASA ARC
Jim Knox NASA MSFC

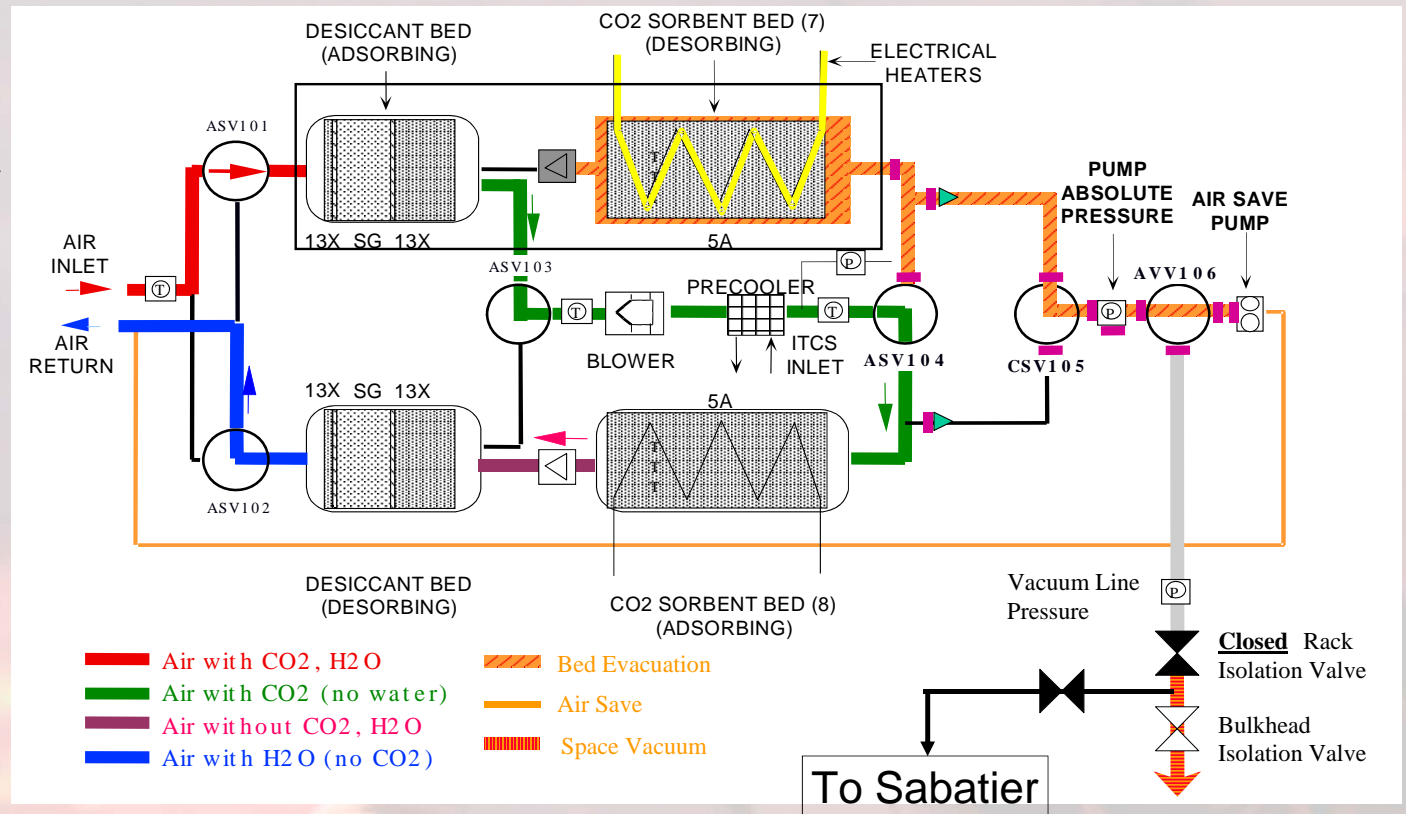


Outline

- Background
- Analysis Instrumentation
- Sorbent Characterization
- Possible Improvements

Background

- Molecular sieve
- Carbon Dioxide Removal Assembly
- 4BMSX



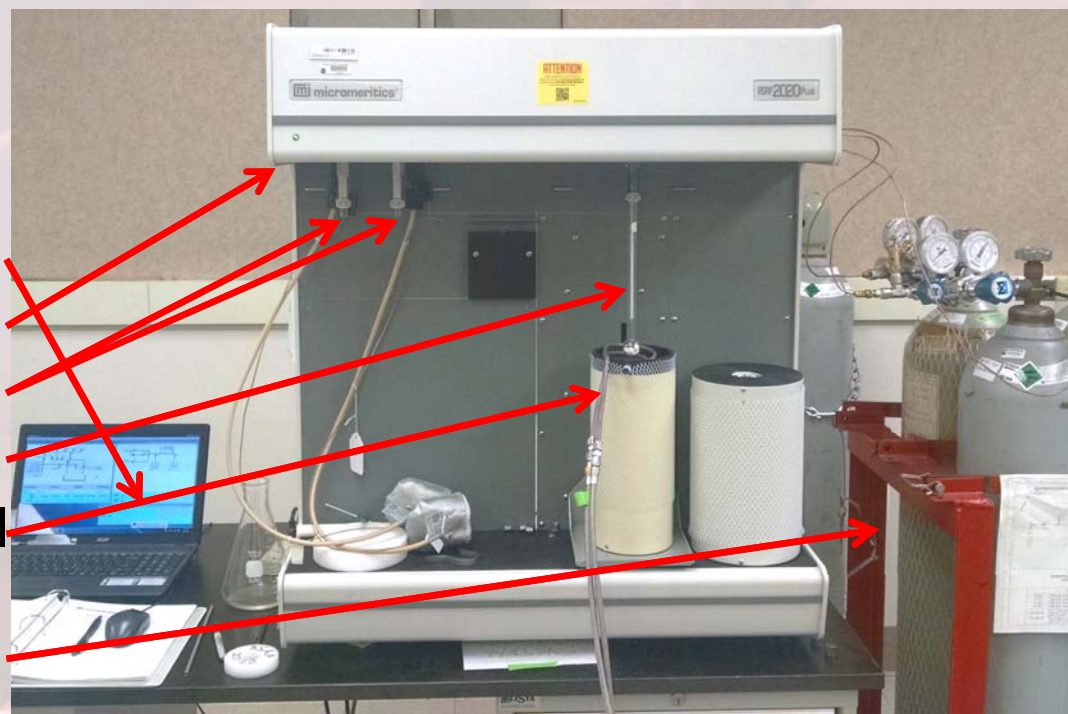
Research Motivation

- Challenges with current SOA
 - Dusting
 - Availability
- Opportunity for improvement
 - Mass
 - Volume
 - Robustness
- Sorbent characterization efforts
- Mechanical crush strength (MSFC)
- H₂O and CO₂ adsorption capacity (ARC)
 - Silica Gel
 - Zeolite



Analysis Instrumentation

- Micromeritics ASAP 2020
- Volumetric adsorption capacity analysis
- P min 4mTorr
- T range
- 0C-75C
- Analysis Computer
 - ASAP 2020
 - Degas Ports
 - Analysis Port
- Temperature Control Bath
- Analysis Gases



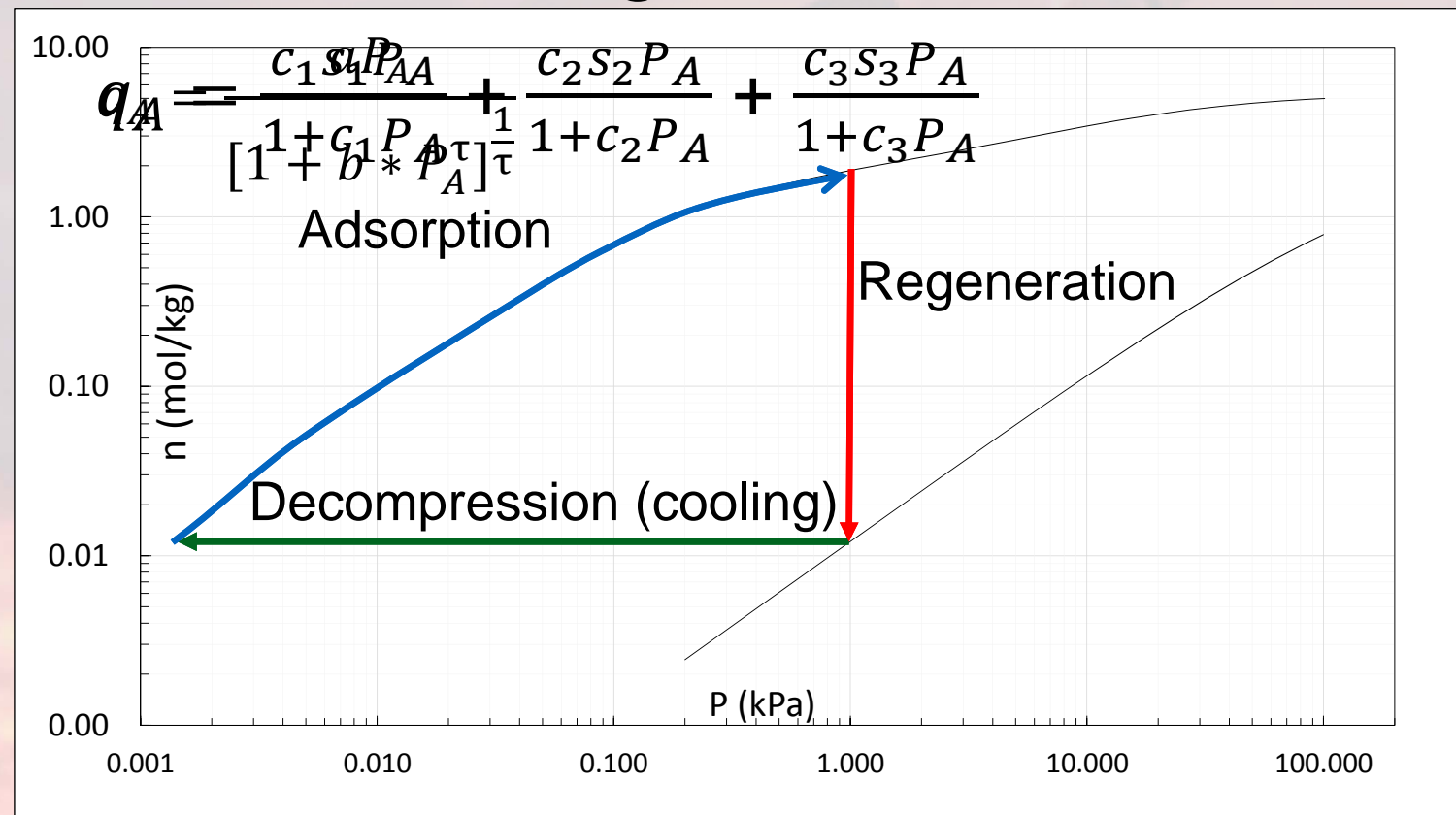
Analysis Method

- ASAP 2020 software package
 - Sample preparation
 - Free space measurement
 - P_0 and analysis temperature definition
 - Dosing method
 - Equilibration parameters



Sorbent Characterization through Empirical Modeling

- Isotherms
- Toth Model
- Langmuir 3-site Model

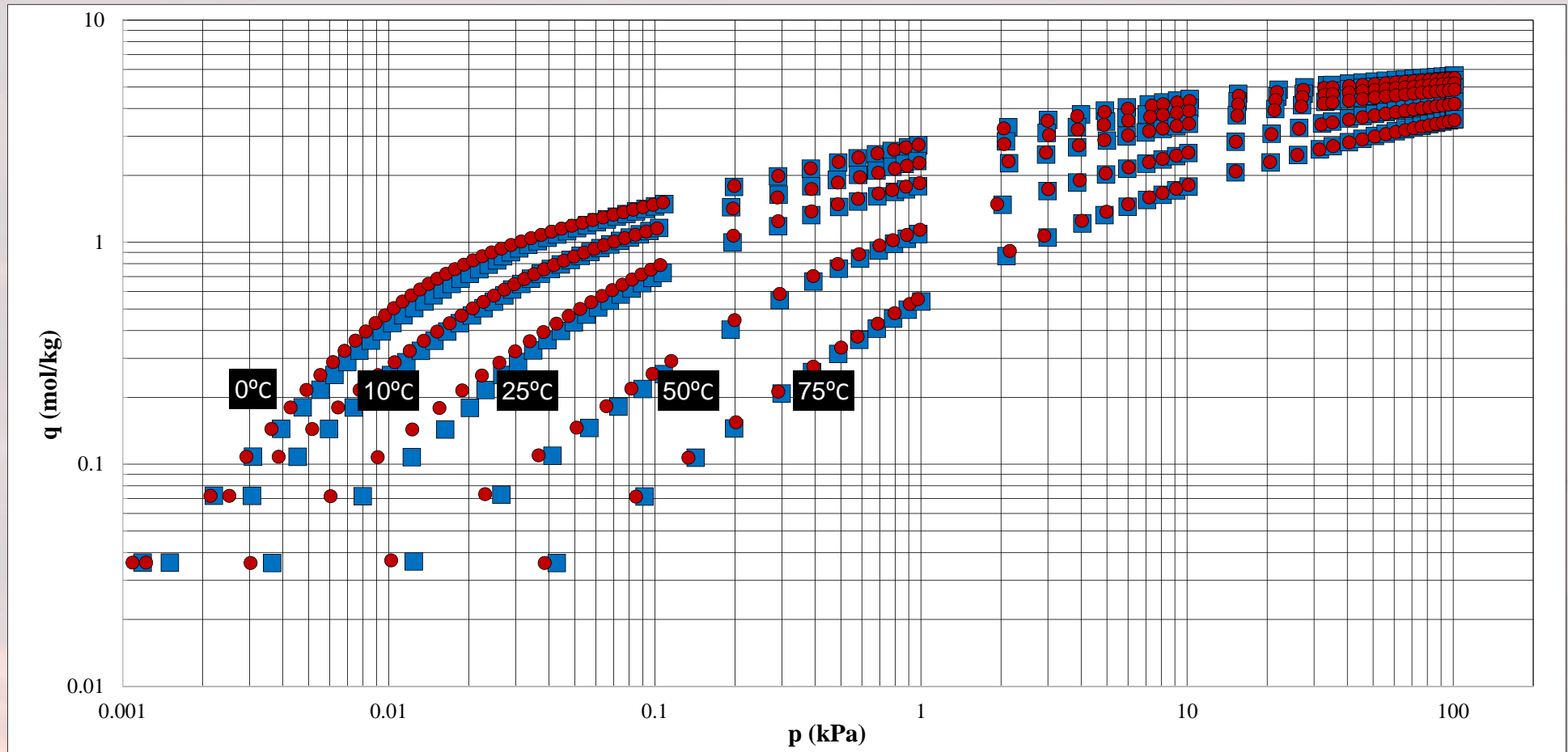


Sorbents of Interest

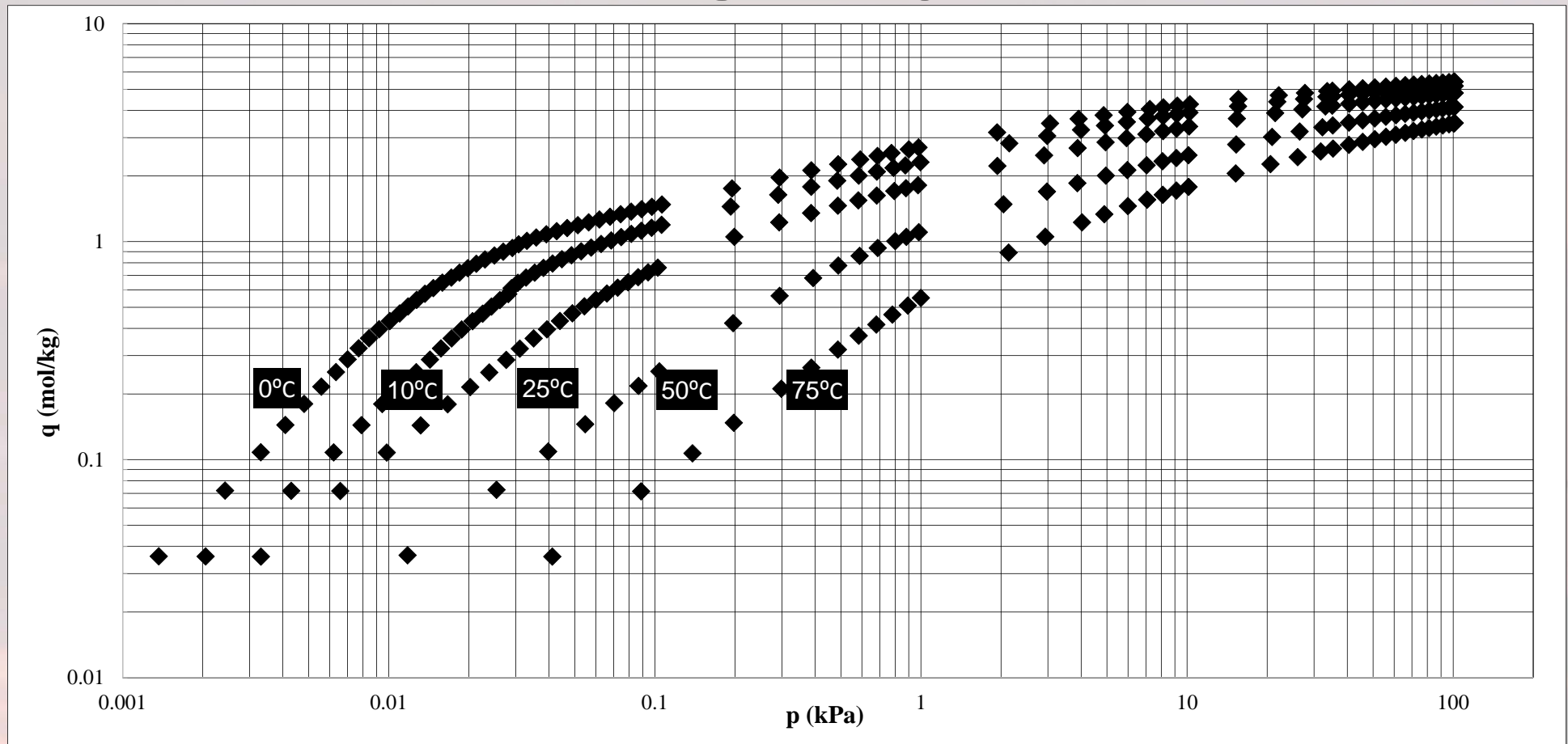
| Name | Manufacturer | Form Factor | Type |
|---------------|---------------|-------------|---------|
| Grade 544 13X | Grace Davison | Bead | Zeolite |
| BASF 13X | BASF | Bead | Zeolite |
| Grade 522 5A | Grace Davison | Bead | Zeolite |
| Grade 514 4A | Grace Davison | Bead | Zeolite |
| APG-III | Honeywell UOP | Bead | Zeolite |
| VSA-10 | Honeywell UOP | Bead | LiLSX |



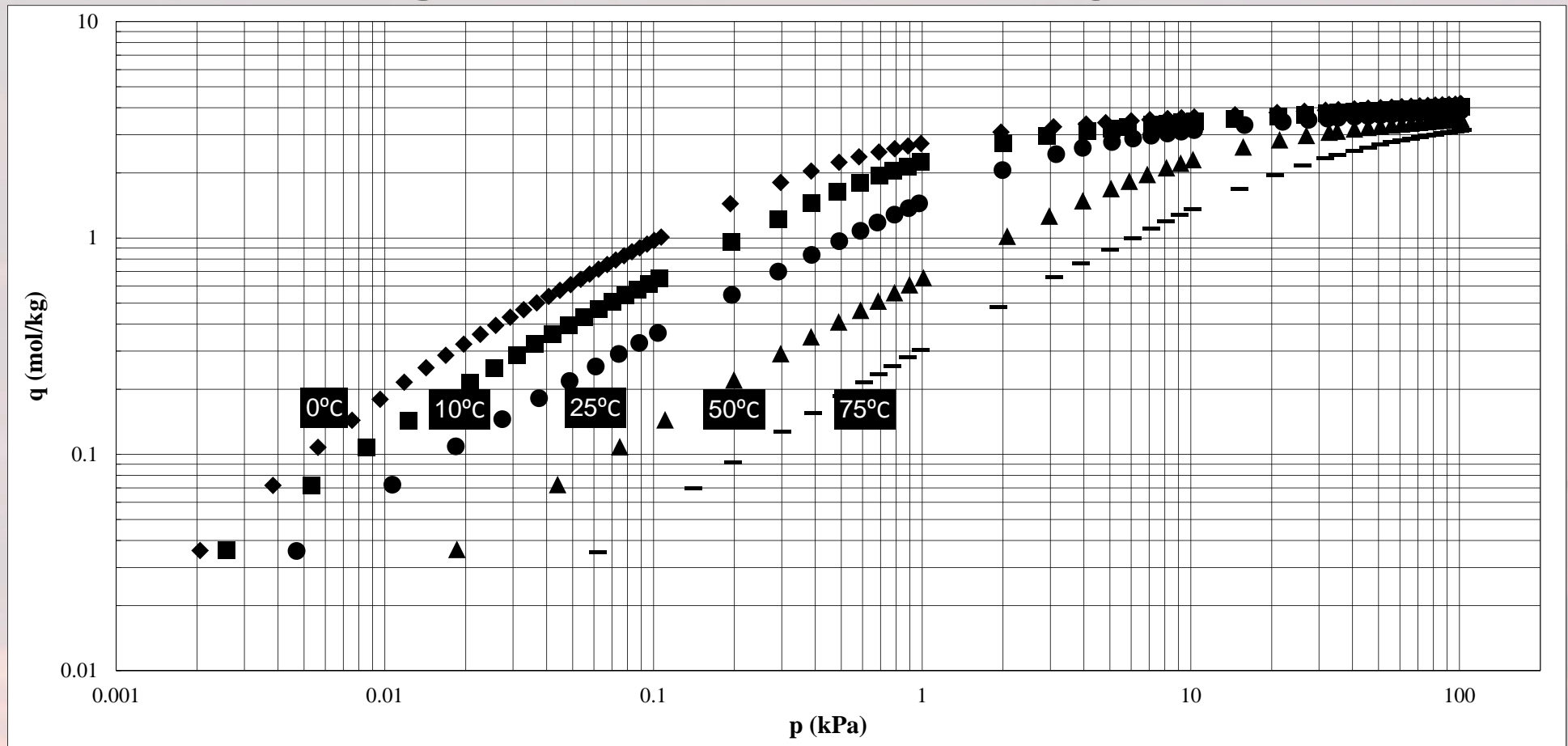
Grace Davison 544 13X



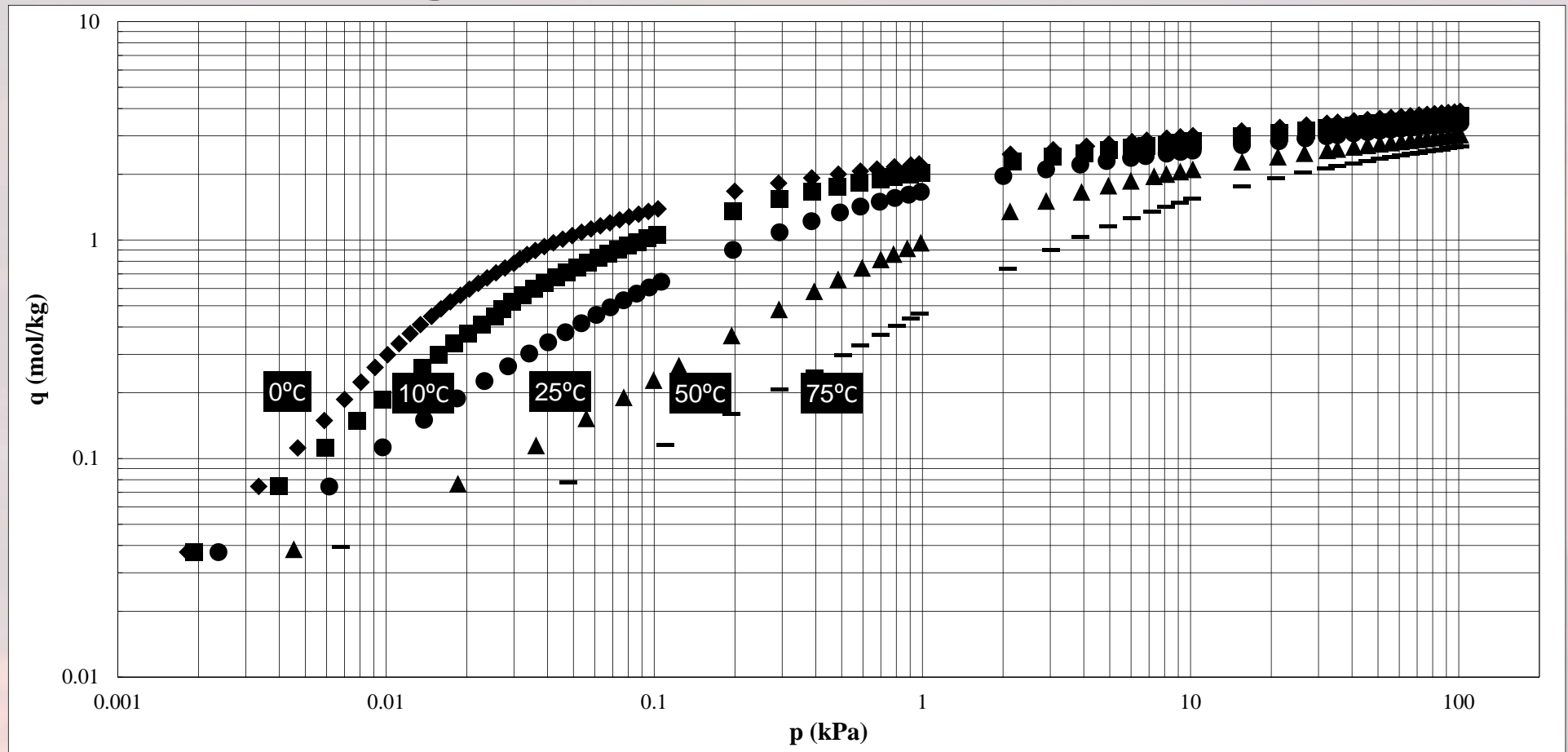
BASF 13X



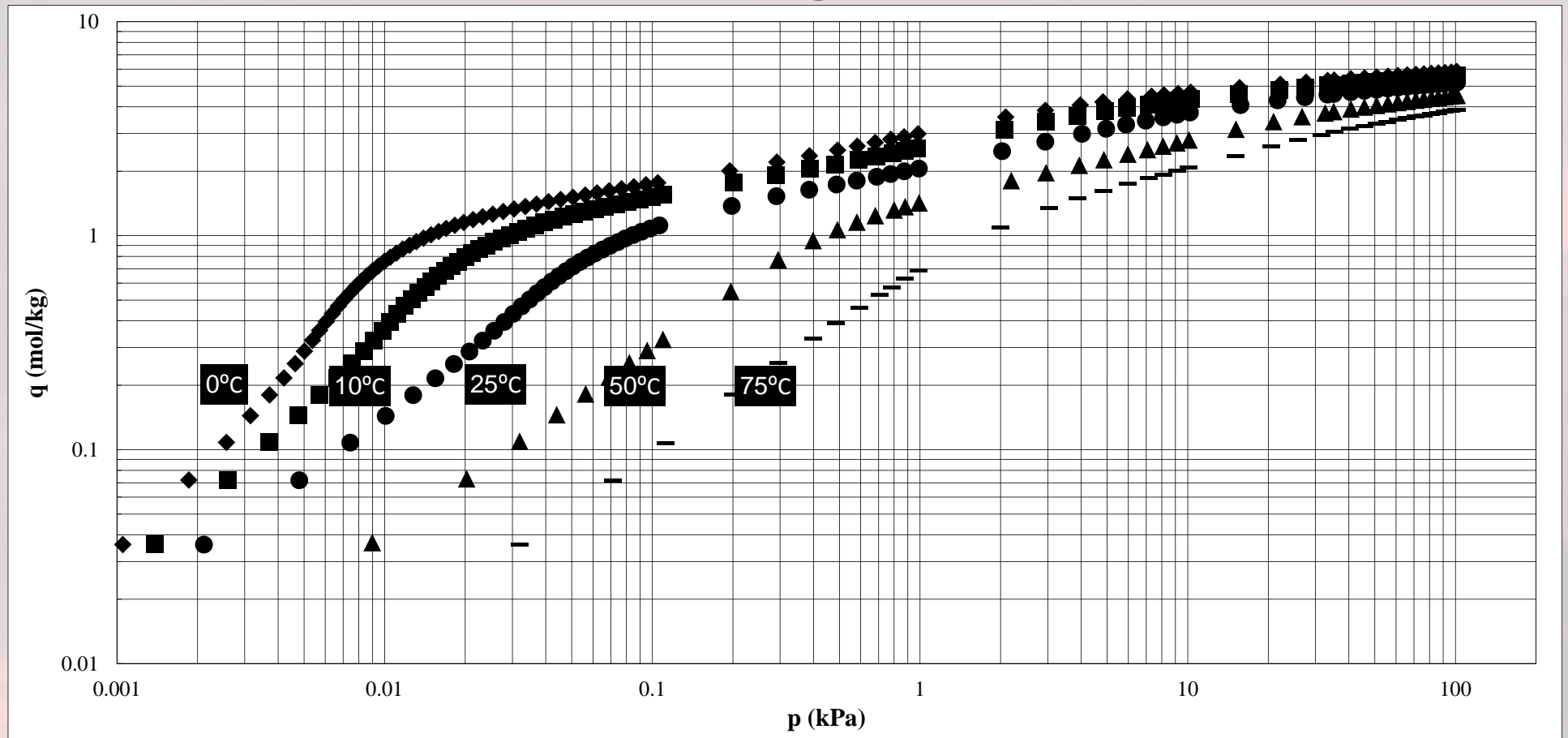
Grace Davison 5A



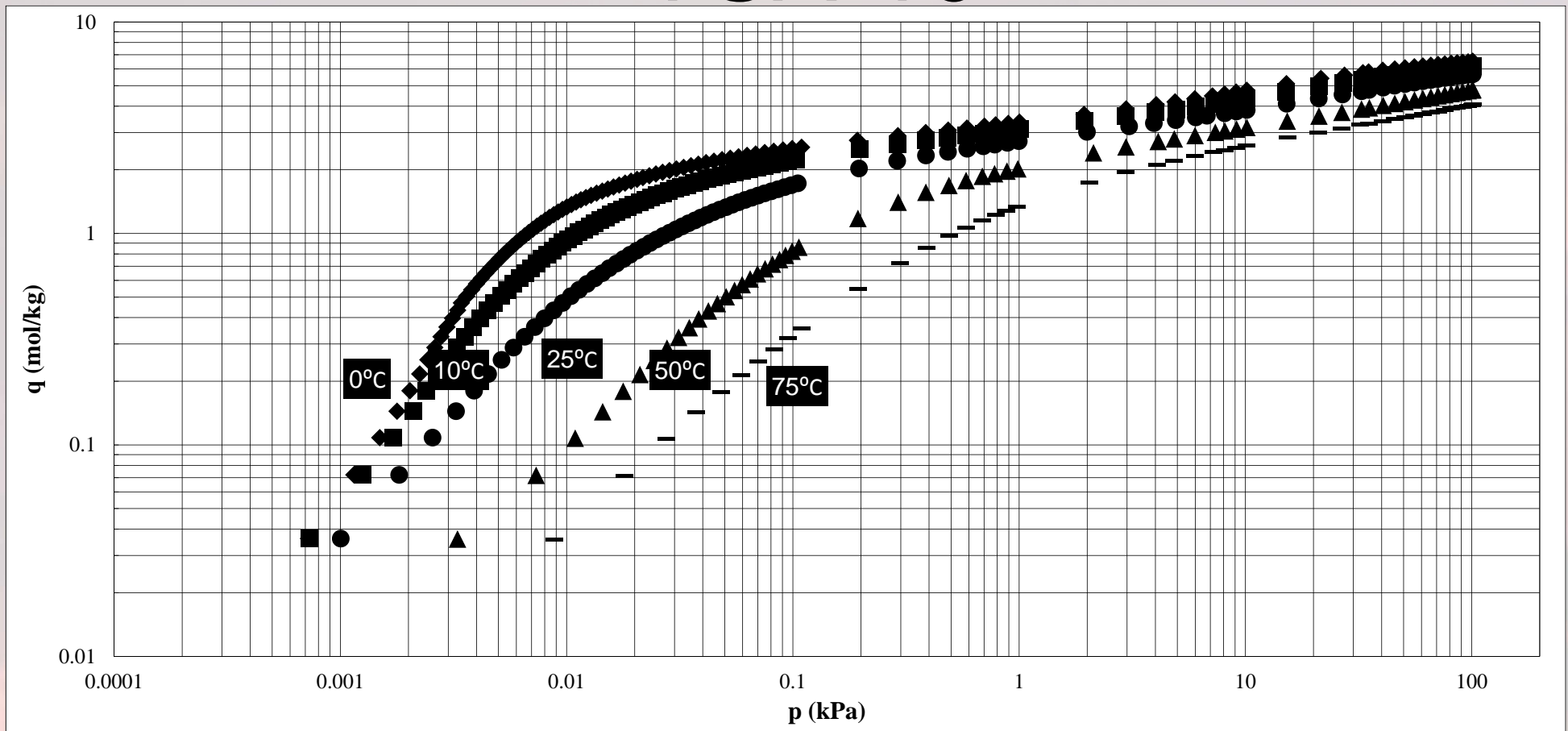
Grace Davison 4A



APG III

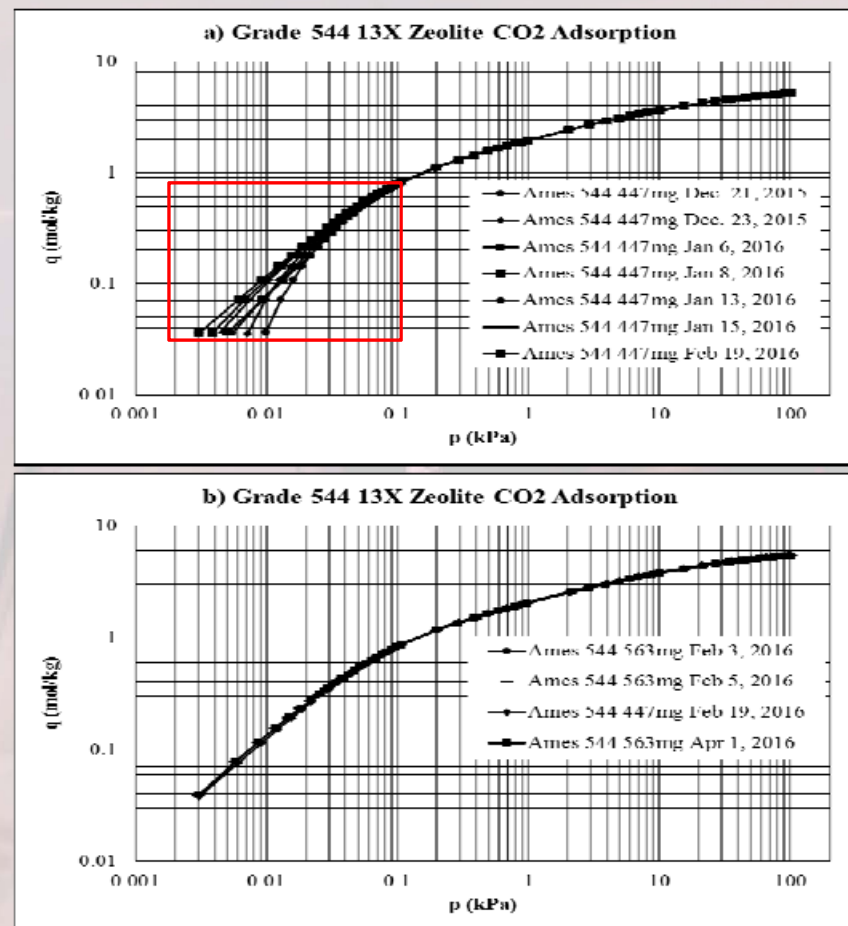


VSA-10



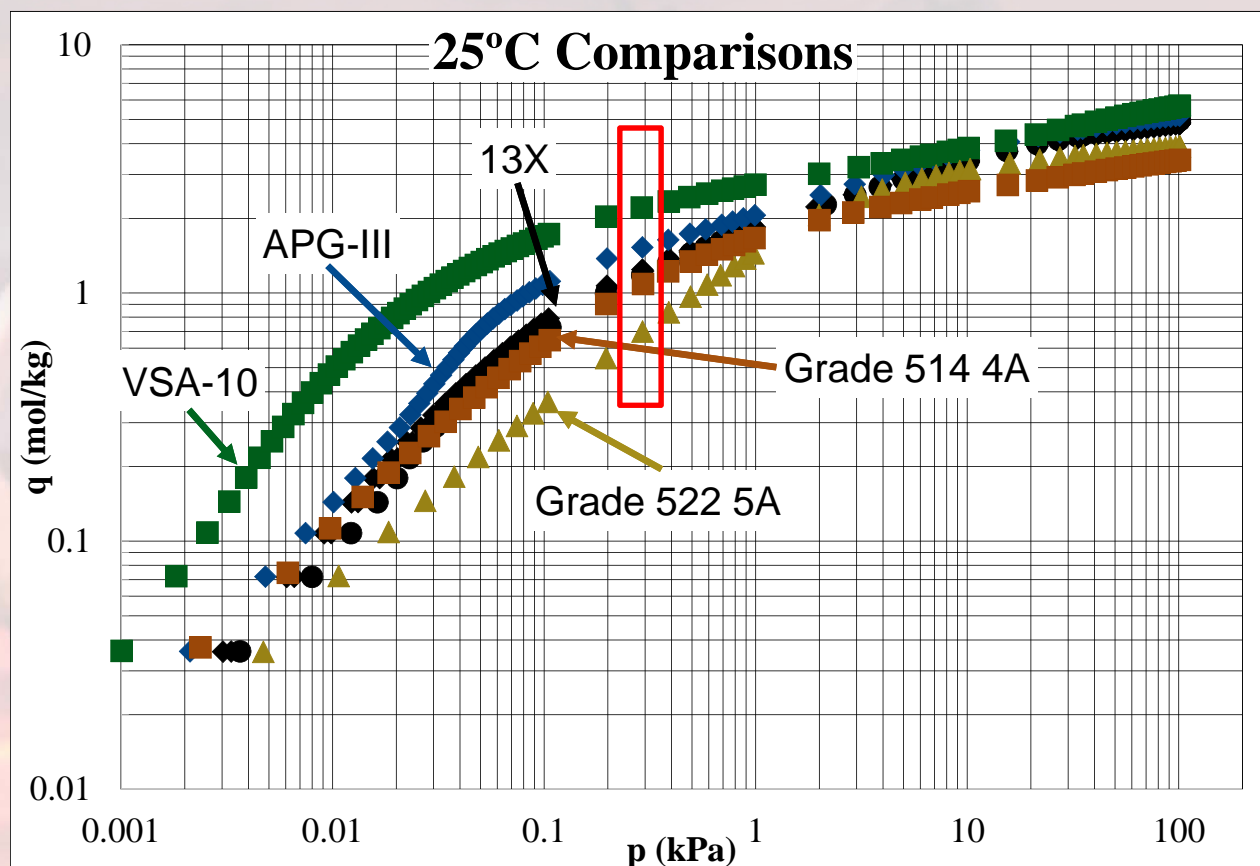
Procedural Lessons Learned

- Issues observed
- Data deviation at low pressures with analysis of the same sample
- Sorbent activation performed on Analysis Port rather than designated Degas Ports



Conclusions

- Tailored sample analysis parameters
- Current settings best for 13X, 5A
- LiLSX VSA-10 and APG-III materials show better CO₂ sorption capacity
- Datasets produce reasonable basis for system modelling



Acknowledgements

- Dr. Armin Ebner, University of South Carolina Chemical Engineering
- Dr. Jim Ritter, University of South Carolina Chemical Engineering
- Gregory Cmarik, NASA Marshall Space Flight Center